PHASE ONE: BREAK DOWN
ENERGY EXCHANGE

Mission: What determines whether energy will transfer?

Age: 8+
Materials: $5

Time: 25 min
(Set-up: 5 min | Activity: 15 min | Clean-up: 5 min)

NGSS Alignment of Energy Exchange Activity

The information below may not include every area that this activity can be linked to NGSS concepts

Disciplinary Core Ideas

PS2.A: Forces and Motion

- **Grade 3**
  - ◇ Each force acts on one particular object and has both strength and a direction.
  - ◇ The patterns of an object's motion in various situations can be observed and measured; when the past motion exhibits a regular pattern, future motion can be predicted from it.
- **Middle School**
  - ◇ The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, a larger force causes a larger change in motion.
  - ◇ All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size.

PS2.B: Types of Interactions

- **Grade 3**
  - ◇ Objects in contact exert forces on each other.
- **Middle School**
  - ◇ Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have a large mass.
  - ◇ Forces that act at a distance can be explained by fields that extend through space and can be mapped by their effect on a test object.

PS3.A: Definitions of Energy

- **Grade 4**
  - ◇ The faster a given object is moving; the more energy it possesses.
  - ◇ Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion.

PS3.B: Conservation of Energy and Energy Transfer

- **Grade 4**
  - ◇ Energy is present whenever there are moving objects, sound, light, or heat.
- **Middle School**
  - ◇ When the motion of energy of an object changes, there is inevitably some other change in energy at the same time.

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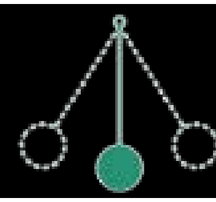

Disciplinary Core Ideas

PS3.D: Energy in Chemical Processes and Everyday Life

- Grade 4
  - ◇ The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use.

PS4.A: Wave Properties

- Middle School
  - ◇ A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.

ETS1.A: Defining Engineering Problems

- Middle School
  - ◇ Possible solutions to a problem are limited by available materials and resources.

Performance Expectations

3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-2 Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

4-PS3-2 Ask questions and predict outcomes about the changes in energy that occur when objects collide.

4-PS3-4 Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

MS-PS2-2 Plan an investigation to provide evidence that change in an object's motion depends on the sum of the forces on the object and the mass of the object.

MS-PS2-4 Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

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Performance Expectations

MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.

MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

Crosscutting Concepts:

Patterns
- Grade 3
  - ◇ Patterns of change can be used to make predictions.

Cause and Effect
- Grade 3
  - ◇ Cause and effect relationships are routinely identified.
- Middle School
  - ◇ Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Energy and Matter
- Grade 4
  - ◇ Energy can be transferred in various ways between objects.
- Middle School
  - ◇ Energy may take different forms.

Influence of Science, Engineering and Technology on Society and the Natural World
- Grade 4
  - ◇ Engineers improve existing technologies or develop new ones.

Stability and Change
- Middle School
  - ◇ Explanations of stability ad change in natural or designed systems can be constructed by examining the changes over time and forces at different scales.

Systems and System Models
- Middle School
  - ◇ Models can be used to represent systems and their interactions - such as inputs, processes and outputs, and energy and matter flows within systems.

Engineering and Science Practices

Planning and Carrying Out Investigations

- Grade 3-5
    - Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered.
    - Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Middle School
    - Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim.

Constructing Explanations and Designing Solutions

- Grade 3-5
    - Apply scientific ideas to solve design problems.

Developing and Using Models

- Middle School
    - Develop a model to describe unobservable and mechanisms.